Roadmap Development: Combining prior architectural, use case, and technology analysis prior work assembled a technology roadmap development plan, with metrics, as input the CICT next generation research plan. The roadmap and metrics are summarized below and discussed in-depth with CICT program managers. The expected impact of development of these capabilities include substantial societal benefit;

- Environmental knowledge, events and predictions should be as available to the general public as textual and pictorial data are available today on the web.
- For deep space missions can use underlying Knowledge-Building Systems to be able to be goal-oriented, learn about environment and reconfigure, possibly adjusting goals.
- System level reconfigurability based on knowledge-building
- Faster access to and utilization of NASA's data in near real-time operational applications

Near Future Capability	**Near Future Metric**	**2015 Metric**	*2015 Capability*
KNOWLEDGE BUILDING SYSTEMS			
Performance model of global persistence architecture	35 archives (NASA & non-NASA); ~2.5 PB	~200 archives (NASA & non-NASA); ~ 500 PB	***Global persistence***
Implement a economic data services model similar to Ebay	~80 loosely federated nodes (NASA & non-NASA) with pre-determined associations; limited to fixed, scheduled linkages	~500 cooperating nodes (NASA & non-NASA); on-demand service chaining up to 5 links	Robust collaborative economic model
Scalable mining algorithms, plus distributed techniques/languages	One archive, single discipline	Mine cross-discipline 40-year datasets from ~6 archives within 6 months to build knowledgebase relevant to specific applications	Mining long-term holdings for trends analysis
APPLICATIONS OF SCIENCE DIRECTLY USABLE			
Automated quality assessment	Science QA takes several months; operational QA in minutes (in-line with product generation)	Perform equivalent of science QA within a few minutes	Autonomous quality assessment
Adaptive resources optimization	CPU load balancing within a cluster	Balancing all resource types across a service chain	Intelligent resource optimization

CPU advances	Specially designed products available within 1 to 2 hours of acquisition	All relevant level 2 products and spatially registered level 3 products for a given application available within 15 minutes of acquisition	Reduced latency
Autonomic computing; self-healing hardware	Lights out operation of mission critical archives	Lights out operations	Self managing and learning robust systems
INTELLIGENT CYBER-INFRASTRUCTURE (SCIENCE-ENABLING COMMUNICATIONS AND SOFTWARE INFRASTRUCTURE)			
Bench mark datasets for Earth science	Experimental ad hoc application of intelligent algorithms, downstream of production timeline; One algorithm single mission per product; production timelines in months	Distributed on-demand generation using adaptive algorithms; Concurrent processing in 120 service-chains (12 national applications, 10 end-points per application); Production timelines in minutes for selected service chains	Scalable robust intelligent algorithms
Near archive data mining	Limited content-based metadata (e.g., cloud mask products, QA flags); Special purpose content experimentally derived, ad hoc	In-line mining with distributed production; Content information mined for entire datasets (e.g., features, phenomena, events, pre-cursor statistical signatures); Distributed service chains with embedded intelligent algorithm support; 100,000 end users and operations processes.	NASA and ops agency supported by intelligent cyber-infrastructure
STRONGLY INTEROPERABLE FABRIC			
Standard data/science access mechanisms and semantic web	Several common data standards, tools, software packages; extensions of XML to specific disciplines; experimental work in semantic web	Full ontologies for data and services in 200 archives	Automated data discovery and utilization
Search protocol gateway	Portals (e.g., EDG) provide structured pre-computed metadata access to 21 earth science archives selected inventory (9 US and international)	Automated registration of new data and service types and automated linkage to end-user interest	

Feedback Loop			
	Initial efforts at alerting (e.g., solar events, fires, cyclones)	Unsupervised algorithm, multi-anomaly detection capability embedded in at least one mission (on-board acquisition stage) for rapid operational awareness/response Autonomous IDU algorithms embedded in all mission data production process Autonomous IDU algorithms scan 24/7 all long-term archives for discovery alerts	Self-analyzing and autonomous anomaly response
Secure OS [*not covered*]	Testbed on-board space TCP/IP connection	Automatic filtering and risk assessment of any commands issued; Secure space-based internet access	***Zero-risk command & control of space assets***
	No near-real-time linking	Resource availability and request queues brokered 24/7; 15 minutes' response time between request for resource by a model and response to model (e.g., request could be mining, drawing from a cache or sensor acquisition)	Linking between modeling and adaptive scheduling

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